

WHAT IS CLAIMED IS:

1. A gas concentration measuring apparatus comprising:
a gas sensor including a cell and a heater, the cell having a
5 solid electrolyte body and working to produce a sensor signal in the
form of an electrical change as a function of concentration of a
given component of gas, the heater working to heat the solid
electrolyte body; and
a measurement control circuit designed to perform a heater
10 power supply control function and an averaging function, the
heater power supply control function working to control supply of
power to the heater to elevate temperature of the solid electrolyte
body up to a desired activation temperature thereof, the averaging
function working to average the sensor signal outputted from said
15 gas sensor for a given averaging time range so that a first
component of the sensor signal to which a noise arising from a
change in the power supplied to the heater is added cancels a
second component of the sensor signal to which a noise arising
from a change in the power supplied to the heater is added and
20 which is reverse in level to the first component to produce an
averaged value, said measurement control circuit determining the
concentration of the given component of the gas using the averaged
value.
- 25 2. A gas concentration measuring apparatus as set forth in

claim 1, wherein said measurement control circuit controls the supply of power to the heater using a pulse width modulated (PWM) signal so as to place the heater in an on-state and an off-state cyclically, and wherein the noise added to the first
5 component of the sensor signal arises from a switch from the off-state to the on-state of the heater, and the noise added to the second component of the sensor signal arises from a switch from the on-state to the off-state of the heater.

10 3. A gas concentration measuring apparatus as set forth in claim 2, wherein the averaging time range is identical with a time interval which starts from a leading end of an on-time for which the heater is placed in the on-state and terminates at a trailing end of an off-time for which the heater is placed in the off-state.

15 4. A gas concentration measuring apparatus as set forth in claim 2, wherein said measurement control circuit collects samples of the sensor signal at a given sampling interval and averages the samples over the averaging time range.

20 5. A gas concentration measuring apparatus as set forth in claim 4, wherein said measurement control circuit calculates a moving average as the averaged value.

25 6. A gas concentration measuring apparatus as set forth in

claim 5, wherein the averaging time range is a natural number multiple of a cycle of the PWM signal.

7. A gas concentration measuring apparatus as set forth in
5 claim 6, wherein the cycle of the PWM signal is a natural number multiple of the sampling cycle of the sensor signal.

8. A gas concentration measuring apparatus as set forth in
claim 1, further comprising a high-frequency component removing
10 circuit which works to remove a high-frequency component from the sensor signal outputted from said gas sensor.

9. A gas concentration measuring apparatus as set forth in
claim 1, wherein said gas sensor includes a first cell and a second
15 cell, the first cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas chamber to produce a sensor signal in the form of an electrical change as a function of concentration of the oxygen, the second cell working to produce a
20 sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, and wherein said cell is one of the first and second cells.

25 10. A gas concentration measuring apparatus as set forth in

claim 1, wherein said gas sensor is formed by a lamination of the cell and the heater.

11. A gas concentration measuring apparatus as set forth in
5 claim 1, wherein said gas sensor includes a pump cell, a sensor
cell, and a monitor cell, the pump cell working to pump oxygen
contained in the gas admitted into a gas chamber out of the gas
chamber or oxygen into the gas chamber from outside the gas
chamber to produce a sensor signal in the form of an electrical
10 change, the sensor cell working to produce a sensor signal in the
form of an electrical change as a function of concentration of a
predetermined component of the gas flowing from the gas chamber,
the monitor cell working to produce a sensor signal in the form of
an electrical change as a function of concentration of the oxygen
15 remaining within the gas chamber, and wherein said cell is one of
the pump cell, the sensor cell, and the monitor cell.

12. A gas concentration measuring apparatus as set forth in
claim 11, wherein the averaging function also works to average at
20 least one of the sensor signals outputted from the pump cell, the
sensor cell, and the monitor cell other than the sensor signal of
said cell.

13. A gas concentration measuring apparatus comprising:
25 a gas sensor including a cell and a heater, the cell having a

solid electrolyte body and working to produce a sensor signal in the form of an electrical change as a function of concentration of a given component of gas, the heater working to heat the solid electrolyte body up to a desired activation temperature thereof; and
5 a measurement control circuit designed to perform a heater power supply control function, the heater power supply control function working to control supply of power to the heater using a pulse width modulated (PWM) signal so as to place the heater in an on-state and an off-state cyclically, said measurement control
10 circuit sampling the sensor signal cyclically and determining concentration of the given component of the gas using each of sampled values of the sensor signal, when a change in level of one of the sampled values collected in a current sampling cycle from one of the sampled values collected in a previous sampling cycle is
15 greater than a given limit, the sampled value in the current sampling cycle being corrected to a value within a range extending across the sampled value in the previous sampling cycle.

14. A gas concentration measuring apparatus as set forth in
20 claim 13, wherein said gas sensor includes a first cell and a second cell, the first cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas chamber to produce a sensor signal in the form of an electrical change as a function of
25 concentration of the oxygen, the second cell working to produce a

sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, and wherein said cell is one of the first and second cells.

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15. A gas concentration measuring apparatus as set forth in claim 13, wherein said gas sensor is formed by a lamination of the cell and the heater.

10 16. A gas concentration measuring apparatus as set forth in claim 13, wherein said gas sensor includes a pump cell, a sensor cell, and a monitor cell, the pump cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas
15 chamber to produce a sensor signal in the form of an electrical change, the sensor cell working to produce a sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, the monitor cell working to produce a sensor signal in the form of
20 an electrical change as a function of concentration of the oxygen remaining within the gas chamber, and wherein said cell is one of the pump cell, the sensor cell, and the monitor cell.

17. A gas concentration measuring apparatus as set forth in
25 claim 16, wherein said measurement control circuit also samples

at least one of the sensor signals of the pump cell, the sensor cell, and the monitor cell other than the sensor signal of said cell, when a change in level of one of the sampled values of the at least one of the sensor signals which is collected in a current sampling cycle
5 from one of the sampled values collected in a previous sampling cycle is greater than the given limit, the sampled value in the current sampling cycle being corrected to a value within a range extending across the sampled value in the previous sampling cycle.

- 10 18. A gas concentration measuring apparatus comprising:
a gas sensor including a cell and a heater, the cell having a solid electrolyte body and working to produce a sensor signal in the form of an electrical change as a function of concentration of a given component of gas, the heater working to heat the solid
15 electrolyte body; and
a measurement control circuit designed to perform a heater power supply control function, the heater power supply control function working to control supply of power to the heater using a pulse width modulated (PWM) signal so as to place the heater in an
20 on-state and an off-state cyclically to elevate temperature of the solid electrolyte body up to a desired activation temperature, said measurement control circuit receiving an input of the sensor signal and including a high frequency component removing circuit working to remove a high frequency component from the input of
25 the sensor signal and to produce a high frequency-removed signal,

said measurement control circuit determining concentration of the given component of the gas as a function of the high frequency-removed signal.

5 19. A gas concentration measuring apparatus as set forth in claim 18, wherein said gas sensor includes a first cell and a second cell, the first cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas chamber to produce a sensor
10 signal in the form of an electrical change as a function of concentration of the oxygen, the second cell working to produce a sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, and wherein said cell is one of the first and
15 second cells.

20. A gas concentration measuring apparatus as set forth in claim 18, wherein said gas sensor is formed by a lamination of the cell and the heater.

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21. A gas concentration measuring apparatus as set forth in claim 18, wherein said gas sensor includes a pump cell, a sensor cell, and a monitor cell, the pump cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas
25 chamber or oxygen into the gas chamber from outside the gas

chamber to produce a sensor signal in the form of an electrical change, the sensor cell working to produce a sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, the monitor cell working to produce a sensor signal in the form of an electrical change as a function of concentration of the oxygen remaining within the gas chamber, and wherein said cell is one of the pump cell, the sensor cell, and the monitor cell.

22. A gas concentration measuring apparatus as set forth in claim 21, wherein the high frequency component removing circuit also works to remove a high frequency component from at least one of the sensor signals outputted from the pump cell, the sensor cell, and the monitor cell other than the sensor signal of said cell.

23. A gas concentration measuring apparatus comprising:
a gas sensor including a cell and a heater, the cell having a solid electrolyte body and working to produce a sensor signal in the form of an electrical change as a function of concentration of a given component of gas, the heater working to heat the solid electrolyte body; and

a measurement control circuit designed to perform a heater power supply control function, the heater power supply control function working to control supply of power to the heater using a pulse width modulated (PWM) signal so as to place the heater in an

on-state and an off-state cyclically to elevate temperature of the solid electrolyte body up to a desired activation temperature, said measurement control circuit sampling the sensor signal cyclically and including a sample availability determining circuit working to
5 determine whether samples of the sensor signal are available to determination of the concentration of the given component of the gas in terms of an electrical noise or not, said sample availability determining circuit working to determine one of the samples acquired upon a switch between the on-state and the off-state of
10 the heater to be unavailable, said measurement control circuit determining the concentration of the given component of the gas using the samples of the sensor signal from which the one determined to be unavailable is removed.

15 24. A gas concentration measuring apparatus as set forth in claim 23, wherein said gas sensor includes a first cell and a second cell, the first cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas chamber to produce a sensor
20 signal in the form of an electrical change as a function of concentration of the oxygen, the second cell working to produce a sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, and wherein said cell is one of the first and
25 second cells.

25. A gas concentration measuring apparatus as set forth in claim 23, wherein said gas sensor is formed by a lamination of the cell and the heater.

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26. A gas concentration measuring apparatus as set forth in claim 23, wherein said gas sensor includes a pump cell, a sensor cell, and a monitor cell, the pump cell working to pump oxygen contained in the gas admitted into a gas chamber out of the gas chamber or oxygen into the gas chamber from outside the gas chamber to produce a sensor signal in the form of an electrical change, the sensor cell working to produce a sensor signal in the form of an electrical change as a function of concentration of a predetermined component of the gas flowing from the gas chamber, the monitor cell working to produce a sensor signal in the form of an electrical change as a function of concentration of the oxygen remaining within the gas chamber, and wherein said cell is one of the pump cell, the sensor cell, and the monitor cell.

27. A gas concentration measuring apparatus as set forth in claim 26, wherein the sample availability determining circuit also works to determine whether samples of at least one of the sensor signals outputted from the pump cell, the sensor cell, and the monitor cell other than the sensor signal of said cell are available or not.